West coast of Newfoundland capelin (*Mallotus villosus* M.) and Atlantic herring (*Clupea harengus harengus* L.) larval survey, part 5: Description of the data collected in partnership with the industry (Barry Group) in July 2007

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2008

WEST COAST OF NEWFOUNDLAND CAPELIN (*Mallotus villosus* M.) AND ATLANTIC HERRING (*Clupea harengus harengus* L.) LARVAL SURVEY, PART 5: DESCRIPTION OF THE DATA COLLECTED IN PARTNERSHIP WITH THE INDUSTRY (BARRY GROUP) IN JULY 2007

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ABSTRACT

Grégoire, F., W. Barry, J. Barry, C. Lévesque, J.-L. Beaulieu, and M.-H. Gendron. 2008. West coast of Newfoundland capelin (*Mallotus villosus* M.) and Atlantic herring (*Clupea harengus harengus* L.) larval survey, part 5: Description of the data collected in partnership with the industry (Barry Group) in July 2007. Can. Data Rep. Fish. Aquat. Sci. 1205: vi + 31 pp.

In partnership with the Barry Group in Corner Brook, a larval survey was conducted on the west coast of Newfoundland from July 18 to 21, 2007. Eggs and larvae of several of species of fish were found at all sampled stations. The two most abundant groups of eggs were CYT (cunner [*Tautogolabrus adspersus*] and yellowtail flounder [*Limanda ferruginea*]) and CHW (cod [*Gadus morhua*], haddock [*Melanogrammus aeglefinus*], and witch flounder [*Glyptocephalus cynoglossus*]). Mackerel eggs (*Scomber scombrus*) were found at most of the stations. Of the thirteen species of larvae identified, the most abundant were those of cunner, righteye flounder (Pleuronectidae), mackerel, fourbeard rockling (*Enchelyopus cimbrus)*, and capelin (*Mallotus villosus*). Depth-based profiles of water temperature and salinity were made for each station. All the biological and oceanographic data collected during the survey were compiled and are presented in the tables, figures, and appendices found in this document. These data will be analyzed and published in a forthcoming report.

RÉSUMÉ

Grégoire, F., W. Barry, J. Barry, C. Lévesque, J.-L. Beaulieu et M.-H. Gendron. 2008. West coast of Newfoundland capelin (*Mallotus villosus* M.) and Atlantic herring (*Clupea harengus harengus* L.) larval survey, part 5: Description of the data collected in partnership with the industry (Barry Group) in July 2007. Can. Data Rep. Fish. Aquat. Sci. 1205: vi + 31 pp.

En partenariat avec le Groupe Barry de Corner Brook, un relevé larvaire a été réalisé sur la côte ouest de Terre-Neuve entre le 18 et le 21 juillet 2007. Des œufs et des larves de plusieurs espèces de poissons ont été retrouvés à toutes les stations échantillonnées. Les deux plus abondants groupes d'œufs ont été CYT (tanche-tautogue [*Tautogolabrus adspersus*] et limande à queue jaune [*Limanda ferruginea*]) et CHW (morue [*Gadus morhua*], aiglefin [*Melanogrammus aeglefinus*] et plie grise [*Glyptocephalus cynoglossus*]). Des œufs de maquereau (*Scomber scombrus*) ont été retrouvés à la plupart des stations. Des treize espèces de larves identifiées, les plus importantes ont été celles de la tanche-tautogue, de la plie (Pleuronectidae), du maquereau, de la motelle à quatre barbillons (*Enchelyopus cimbrus)* et du capelan (*Mallotus villosus*). Des profils de la température et de la salinité de l'eau en fonction de la profondeur ont été réalisés à chaque station. Toutes les données biologiques et océanographiques recueillies lors du relevé ont été compilées et sont présentées dans les tableaux, figures et annexes du présent document. Ces données seront analysées et publiées dans un rapport à venir.

INTRODUCTION

In collaboration with the industry, a plankton survey was conducted on the west coast of Newfoundland in July 2004 and 2005. The objective was to collect basic information on the distribution and abundance of capelin and herring larvae in an active fishing area located close to the coast, between Bonne Bay and Port au Port Bay (Figure 1). This area of the west coast of Newfoundland had never before been covered by this type of survey. Eggs from three species and three groups of species were identified as well as the larvae from 16 to 20 species (Grégoire et al. 2005, 2006a). The average abundances of capelin and herring larvae were estimated, and various biodiversity measurements indicated that the larval community structure in the sampled area was characterized by the occurrence of a large number of scarce species and by commercial species concentrated in specific locations (Grégoire et al. 2006b).

A third plankton survey was conducted in July 2007, again with the financial and logistic support of the Barry Group. While the objective was the same, the sampling area was extended to include St. George's Bay (Figure 1).

The present report compiles and documents the biological and oceanographic data collected during the 2007 survey. The detailed analysis of these data will be presented in a forthcoming report.

MATERIAL AND METHODS

Plankton sampling was made by the *Ocean Provider*, a large seiner from the west coast of Newfoundland. The sampling procedures were the same as those performed in 2004 and 2005: At each station, plankton was collected using a 61 cm bongo sampler equipped with two nets lined with 333 µm mesh (Posgay and Marak, 1980). A General Oceanics flowmeter was placed at the opening of each net to measure the volume of water filtered. The 10-min tows were carried out following a saw-tooth pattern (Hempel, 1973) between the surface and a maximum depth of 50 m, or to within 5 m of the bottom at shallower stations. Once on deck, the nets were raised and rinsed with seawater. The plankton sample from the first net was preserved in a diluted buffered formaldehyde solution (4-5%) (Hunter, 1985) while that of the second net was placed in a concentrated ethanol solution (95%). A CTD instrument (Sea-Bird Electronics Inc.) was installed on the bongo sampler to obtain a profile of water temperature and salinity in the water column.

Plankton sorting was performed at the Fisheries and Oceans laboratory in Mont-Joli, Québec, during the fall of 2007. Each sample was split using the Van Guelpen beaker technique (Van Guelpen et al. 1982). The criteria used to identify fish eggs and larvae were mainly drawn from Fritzsche (1978), Elliott and Jimenez (1981), and Fahay (1983). Total lengths (Hardy, 1978) of capelin, herring, and mackerel larvae preserved in the formaldehyde solution were measured to within 0.01 mm. The larvae preserved in ethanol will be used in growth studies based on otolith microstructure. The results of the sorting were input to data files and validated.

RESULTS

The survey took place between 18 and 21 July 2007. A total of 45 stations were sampled in the study area (Figure 2). Station 22 was not sampled due to the lack of time and a malfunction of the CTD probe occurred at stations 5 and 28. Positions and depths station are presented in Table 1 along with the duration of each tow and the volume of water filtered. Temperature profiles by station are shown in Appendix 1. Mean temperatures and salinities were calculated by depth intervals of 2 m from 0 m to 20 m and by intervals of 5 m between 20 m and 65 m (Tables 2 and 3). Between 0 m and 12 m, warmer water temperatures were found in St. George's Bay and inshore Port au Port Bay and Bay of Islands (Figure 3). Starting from approximately 12–14 m of depth, water temperatures fell quickly at the stations located in the western part of St. George's Bay and for inshore stations in Port au Port Bay and Bay of Islands.

Fish eggs were found at each station (Appendix 2), the most abundant groups of which were CYT and CHW. The CYT group includes eggs of cunner (*Tautogolabrus adspersus*) and yellowtail flounder (*Limanda ferruginea*) and the CHW group cod (*Gadus morhua*), haddock (*Melanogrammus aeglefinus*), and witch flounder (*Glyptocephalus cynoglossus*). Mackerel eggs (*Scomber scombrus*) were found at most of the stations. Mackerel egg stages were identified based on criteria presented in Girard (2000).

The larvae of 13 fish species were also found during the survey (Appendix 3). The most abundant were those of cunner, righteye flounder (Pleuronectidae), mackerel, fourbeard rockling (*Enchelyopus cimbrus)*, and capelin (*Mallotus villosus*). The mean lengths of capelin and herring larvae were 6.49 mm (n=484) (Table 4A) and 14.08 mm (n=86) (Table 4B), respectively. The mean length of mackerel larvae was 3.66 mm (n=714) (Table 4C). Two main modes characterize the length frequency distribution of mackerel larvae (Figure 4) compared to one main mode for capelin and herring larvae.

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Table 1. Description of the stations and tows completed during the capelin and Atlantic herring larval survey of July 2007.

STATION NUMBER	DATE (yyyy-mm-dd)	TIME (hh:mm) (NDT)	LATITUDE °N (degrees minutes)	LONGITUDE °W (degrees minutes)	DEPTH Station bottom (m)	DEPTH Maximum sampled (m)	TOW DURATION (mm:ss)	VOLUME OF WATER FILTERED (m^3)
1	2007-07-21	08:18	49° 09'	58° 12'	111	48	11:09	286
2	2007-07-21	05:49	49° 12'	58° 12'	160	63	12:34	279
3	2007-07-20	18:28	49° 27'	58° 12'	43	34	10:23	249
4	2007-07-20	17:39	49° 33'	58° 12'	61	56	11:08	277
5*	2007-07-18	09:49	49° 06'	58° 18'	51		11:00	203
6	2007-07-21	06:32	49° 11'	58° 18'	135	61	11:56	292
7	2007-07-21	07:13	49° 15'	58° 18'	80	62	10:04	238
8	2007-07-20	19:35	49° 20'	58° 18'	37	30	10:26	251
9	2007-07-20	16:38	49° 27'	58° 18'	56	48	10:57	254
10	2007-07-18	10:28	49° 11'	58° 24'	64	52	10:28	207
11	2007-07-20	14:47	49° 15'	58° 24'	40	33	10:57	277
12	2007-07-20	15:32	49° 20'	58° 24'	47	33	10:34	262
13	2007-07-20	12:51	49° 03'	58° 30'	48	48	11:51	286
14	2007-07-18	11:19	49° 07'	58° 30'	88	51	11:19	216
15	2007-07-20	14:01	49° 12'	58° 30'	65	52	10:27	256
16	2007-07-20	11:17	48° 51'	58° 36'	42	33	10:48	268
17	2007-07-18	14:20	48° 57'	58° 36'	35	24	10:50	242
18	2007-07-18	13:22	49° 03'	58° 36'	44	33	09:58	208
19	2007-07-18	12:37	49° 07'	58° 36'	70	57	12:04	210
20	2007-07-20	09:23	48° 39'	58° 42'	34	28	09:56	245
21	2007-07-20	10:18	48° 45'	58° 42'	27	17	10:03	261
22**			48° 51'	58° 42'				
23	2007-07-18	15:05	48° 57'	58° 42'	31	16	10:07	248
24	2007-07-20	08:37	48° 36'	58° 48'	21	16	10:24	255
25	2007-07-20	08:02	48° 39'	58° 48'	23	17	10:21	262
26	2007-07-20	07:23	48° 42'	58° 48'	16	11	10:01	248
27	2007-07-18	17:15	48° 48'	58° 48'	29	16	10:03	249
28*	2007-07-18	16:18	48° 51'	58° 48'	43		10:31	231
29	2007-07-20	06:37	48° 39'	58° 54'	15	10	10:24	242
30	2007-07-18	18:00	48° 45'	58° 54'	29	19	09:56	245
31	2007-07-18	19:19	48° 39'	59° 06'	43	28	11:10	258
32	2007-07-19	18:35	48° 30'	59° 18'	59	44	12:26	312
33	2007-07-19	06:00	48° 28'	59° 06'	68	47	10:23	244
34	2007-07-19	16:01	48° 28'	58° 54'	63	50	10:14	259
35	2007-07-19	14:47	48° 30'	58° 42'	44	35	11:08	269
36	2007-07-19	14:12	48° 30'	58° 36'	48	33	10:54	253
37	2007-07-19	13:38	48° 27'	58° 36'	89	55	10:14	241
38	2007-07-19	17:33	48° 24'	59° 12'	87	53	10:10	235
39	2007-07-19	06:55	48° 24'	59° 00'	91	50	11:20	256
40	2007-07-19	12:04	48° 24'	58° 48'	44	37	09:51	248
41	2007-07-19	12:49	48° 24'	58° 42'	47	41	10:34	256
42	2007-07-19	07:59	48° 18'	59° 06'	99	52	12:03	263
43	2007-07-19	10:29	48° 18'	58° 54'	104	52	11:47	266
44	2007-07-19	11:11	48° 18'	58° 48'	42	35	10:33	255
45	2007-07-19	09:02	48° 12'	59° 00'	85	54	10:30	249
46	2007-07-19	09:43	48° 13'	58° 54'	34	26	10:43	257

* Malfunction of the CTD probe

** Not sampled

Table 2. Mean water temperature (°C) by depth interval (m) for the stations sampled during the capelin and Atlantic herring larval survey of July 2007.

DEPTH	STATION																					
(m)	1	2	3	4	5*	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22**	23
0-2	16.00	16.90	15.73	14.43		14.82	14.96	16.01	14.49	14.57	14.73	14.78	15.20	13.71	14.51	14.90	14.33	13.85	14.30	15.51	15.69		14.42
2-4	15.96	16.86	15.18	14.38		14.73	14.92	14.85	14.43	14.43	14.23	14.69	14.82	13.62	14.39	14.62	14.22	13.76	14.29	15.46	15.42		14.20
4-6	15.56	16.08	14.64	14.21		14.74	14.84	14.55	14.20	14.29	14.03	14.54	14.52	13.55	14.22	14.43	14.12	13.67	14.24	15.43	15.16		14.03
6-8	14.84	14.90	14.59	14.14		14.70	14.70	14.52	14.02	14.06	13.92	14.44	14.28	13.47	14.11	14.27	13.97	13.56	14.19	15.24	14.94		13.86
8-10	14.29	14.66	14.56	14.12		14.58	14.52	14.51	13.93	13.87	13.79	14.32	14.10	13.37	14.01	14.23	13.90	13.49	14.10	14.75	14.76		13.69
10-12	14.18	14.24	14.51	13.99		14.43	14.33	14.50	13.85	13.69	13.70	13.98	14.01	13.24	13.95	14.19	13.87	13.39	13.79	13.20	14.65		13.65
12-14	14.00	13.75	14.38	13.71		14.22	14.20	14.45	13.73	13.61	13.55	13.78	13.94	13.17	13.80	14.12	13.83	13.12	13.30	11.47	14.48		13.62
14-16	13.82	13.63	13.92	13.38		14.07	14.14	14.35	13.47	13.56	13.42	13.65	13.90	13.14	13.70	13.98	13.81	12.40	13.20	10.69	14.09		13.57
16-18	13.63	13.44	13.55	13.15		13.94	14.03	14.03	13.22	13.53	13.35	13.24	13.83	12.98	13.54	13.74	13.78	11.77	13.08	9.96	13.77		
18-20	13.43	13.27	13.12	12.75		13.78	13.60	13.57	12.99	13.50	13.29	12.56	13.70	12.78	13.23	13.67	13.68	10.98	12.93	9.14			
20-25	12.82	12.53	12.35	10.06		13.39	12.38	12.34	11.69	13.47	12.60	11.19	13.51	12.27	12.27	13.10	13.23	8.58	12.03	7.16			
25-30	11.40	11.26	10.01	5.67		11.36	10.62	8.97	8.66	12.88	9.06	6.95	11.42	10.88	9.72	10.26		6.54	7.93	5.66			
30-35	8.48	9.80	8.21	4.03		7.71	7.49	7.74	4.29	11.17	6.08	5.20	6.22	6.36	4.42	5.12		5.57	5.22				
35-40	4.96	5.24		3.06		5.02	3.93		2.56	6.70			3.73	3.84	2.79				3.20				
40-45	2.98	3.33		2.45		3.26	1.82		1.80	4.37			2.39	2.40	1.79				2.39				
45-50	2.33	1.99		1.38		1.96	1.11		1.44	3.57			2.05	1.80	1.22				1.68				
50-55		1.21		0.27		0.85	0.53			2.95				1.52	0.74				1.01				
55-60		0.59		0.11		0.39	0.06												0.61				
60-65		0.34				0.42	-0.15																

Table 2. (Continued).

DEPTH	STATION																					
(m)	24	25	26	27	28*	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46
0-2	16.10	15.57	15.72	13.97		15.17	13.96	13.62	14.84	15.53	16.07	16.52	17.93	15.70	15.85	15.14	15.37	15.88	15.58	15.27	15.12	15.31	15.27
2-4	16.08	15.46	15.62	13.95		15.01	13.94	13.59	14.44	15.51	15.97	16.30	17.16	15.19	15.72	15.10	15.28	15.75	15.56	15.25	15.08	15.29	15.24
4-6	15.95	15.38	15.47	13.94		14.92	13.93	13.57	14.26	15.17	15.93	15.93	16.65	15.01	15.67	15.08	15.22	15.60	15.48	15.18	15.02	14.79	15.19
6-8	15.72	15.28	15.22	13.93		14.87	13.92	13.55	14.10	14.45	15.79	15.25	16.13	14.87	15.53	14.96	15.10	15.45	15.17	14.98	14.99	14.39	15.15
8-10	15.23	14.91	15.07	13.90		14.62	13.90	13.50	13.95	14.11	15.55	14.79	15.28	14.76	15.08	14.37	14.90	15.21	14.17	14.58	14.92	14.08	15.07
10-12	13.55	14.44	14.95	13.89		14.02	13.89	13.46	13.85	13.93	15.04	14.44	14.83	14.56	14.03	13.74	14.64	14.90	12.19	14.23	14.77	13.55	14.84
12-14	11.25	13.83		13.88			13.87	13.42	13.69	13.79	14.35	14.26	14.56	14.42	13.08	12.37	14.32	14.60	9.20	14.15	14.33	13.26	14.36
14-16	10.64	13.13		13.85			13.87	13.40	13.17	13.59	14.01	14.10	14.16	14.31	11.43	9.95	13.93	14.47	8.00	14.13	13.98	12.85	14.30
16-18		12.47		13.83			13.85	13.39	12.98	12.98	13.60	13.91	13.94	14.11	10.32	8.45	13.76	14.30	6.94	14.03	13.78	11.37	14.16
18-20							13.84	13.39	12.84	11.26	13.16	13.66	13.74	13.90	8.77	7.63	13.56	14.06	6.49	13.76	13.66	9.41	13.85
20-25								13.36	12.42	9.23	10.84	11.40	12.42	12.73	7.28	6.09	11.35	11.04	5.43	12.34	12.67	7.33	11.44
25-30								11.82	11.31	6.68	7.98	5.67	7.62	9.44	5.36	5.08	7.60	5.27	3.95	6.50	7.87	5.42	7.14
30-35									7.73	4.06	6.24	2.09	3.32	3.60	3.84	4.33	4.78	1.78	2.86	4.59	2.96	3.51	
35-40									6.29	2.85	3.37			1.90	3.01	3.36	3.61	0.83	1.89	2.79	2.34	1.97	
40-45									4.44	1.79	2.10			0.91	2.42	2.07		0.77	1.20	1.50		1.15	
45-50										1.38	1.04			0.51	1.85	1.20			0.72	0.80		0.96	
50-55														0.44	1.15	0.89			0.49	0.33		0.48	
55-60																							
60-65																							

* Malfunction of the CTD probe

** Not sampled

Table 3. Mean water salinity by depth interval (m) for the stations sampled during the capelin and Atlantic herring larval survey of July 2007.

DEPTH	STATION																					
(m)	1	2	3	4	5*	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22**	23
0-2	28.15	28.10	30.11	31.37		31.21	31.12	29.59	31.32	31.75	30.98	31.45	31.21	31.60	31.44	31.33	31.56	31.69	31.66	31.26	31.29		31.59
2-4	28.80	28.66	30.94	31.50		31.18	31.06	31.28	31.34	31.63	31.41	31.53	31.40	31.62	31.52	31.43	31.53	31.65	31.62	31.33	31.35		31.58
4-6	30.22	29.88	31.62	31.63		31.18	31.13	31.62	31.56	31.60	31.56	31.63	31.51	31.61	31.58	31.47	31.54	31.65	31.57	31.35	31.41		31.59
6-8	31.12	30.89	31.66	31.66		31.20	31.24	31.63	31.66	31.68	31.62	31.65	31.56	31.61	31.60	31.52	31.58	31.63	31.58	31.36	31.46		31.60
8-10	31.46	31.47	31.66	31.65		31.27	31.39	31.65	31.66	31.69	31.63	31.66	31.57	31.62	31.61	31.52	31.59	31.64	31.59	31.39	31.48		31.60
10-12	31.55	31.60	31.65	31.65		31.37	31.50	31.65	31.66	31.72	31.63	31.65	31.57	31.62	31.62	31.52	31.60	31.64	31.61	31.52	31.50		31.60
12-14	31.54	31.58	31.66	31.65		31.49	31.57	31.65	31.66	31.69	31.64	31.66	31.58	31.63	31.62	31.52	31.61	31.56	31.61	31.62	31.51		31.60
14-16	31.56	31.58	31.66	31.66		31.54	31.58	31.65	31.65	31.68	31.65	31.67	31.59	31.61	31.63	31.53	31.61	31.66	31.65	31.64	31.52		31.60
16-18	31.54	31.58	31.69	31.66		31.54	31.59	31.66	31.66	31.67	31.67	31.68	31.59	31.62	31.64	31.56	31.62	31.74	31.65	31.68	31.56		
18-20	31.56	31.60	31.67	31.67		31.55	31.61	31.67	31.67	31.68	31.67	31.70	31.59	31.61	31.63	31.58	31.63	31.76	31.57	31.72			
20-25	31.57	31.58	31.68	31.79		31.59	31.52	31.69	31.71	31.66	31.66	31.74	31.60	31.67	31.68	31.62	31.71	32.05	31.62	31.80			
25-30	31.57	31.57	31.71	31.97		31.61	31.60	31.83	31.86	31.63	31.76	31.92	31.73	31.75	31.82	31.77		32.15	32.05	31.89			
30-35	31.67	31.66	31.82	32.01		31.74	31.74	31.83	32.03	31.75	31.96	31.99	31.97	32.30	32.10	32.15		32.45	32.19				
35-40	31.88	31.88		32.04		31.92	31.96		32.11	32.17			32.13	32.37	32.16				32.30				
40-45	32.00	32.01		32.07		32.02	32.07		32.13	32.33			32.21	32.36	32.18				32.33				
45-50	32.09	32.08		32.19		32.08	32.08		32.15	32.19			32.23	32.29	32.21				32.42				
50-55		32.12		32.27		32.11	32.10			32.21				32.37	32.23				32.32				
55-60		32.14		32.24		32.14	32.14												32.70				
60-65		32.17				32.25	32.15																

Table 3. (Continued).

DEPTH	STATION																						
(m)	24	25	26	27	28*	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46
0-2	31.13	31.33	31.32	31.56		31.25	31.61	31.53	31.34	31.36	31.42	31.05	29.93	31.11	31.30	31.33	31.41	31.42	31.33	31.33	31.44	31.35	31.33
2-4	31.32	31.36	31.38	31.56		31.40	31.59	31.49	31.34	31.37	31.40	31.11	30.49	31.18	31.37	31.36	31.41	31.38	31.31	31.33	31.43	31.32	31.32
4-6	31.34	31.38	31.41	31.57		31.43	31.59	31.49	31.33	31.42	31.41	31.20	30.88	31.22	31.38	31.36	31.41	31.38	31.32	31.34	31.44	31.34	31.32
6-8	31.36	31.39	31.40	31.57		31.44	31.59	31.49	31.31	31.46	31.41	31.31	31.03	31.25	31.40	31.36	31.44	31.38	31.37	31.39	31.44	31.37	31.31
8-10	31.38	31.41	31.40	31.57		31.47	31.59	31.49	31.31	31.50	31.41	31.39	31.23	31.25	31.39	31.39	31.42	31.40	31.39	31.47	31.44	31.37	31.30
10-12	31.45	31.42	31.43	31.57		31.48	31.59	31.49	31.30	31.52	31.43	31.47	31.38	31.28	31.44	31.44	31.43	31.41	31.54	31.50	31.45	31.38	31.30
12-14	31.58	31.46		31.57			31.59	31.49	31.31	31.53	31.47	31.52	31.46	31.39	31.49	31.57	31.45	31.43	31.76	31.50	31.46	31.42	31.27
14-16	31.68	31.52		31.59			31.59	31.49	31.29	31.55	31.53	31.53	31.50	31.49	31.70	31.78	31.47	31.45	31.90	31.50	31.49	31.50	31.31
16-18		31.60		31.61			31.60	31.49	31.31	31.61	31.54	31.52	31.49	31.50	31.70	31.88	31.48	31.47	31.92	31.51	31.50	31.63	31.44
18-20							31.62	31.49	31.34	31.65	31.58	31.52	31.50	31.51	31.85	31.95	31.52	31.48	31.96	31.53	31.51	31.80	31.50
20-25								31.50	31.45	31.83	31.68	31.57	31.57	31.51	31.89	32.00	31.69	31.65	32.00	31.61	31.60	31.90	31.71
25-30								31.57	31.61	31.97	31.77	32.00	31.88	31.72	32.00	32.01	31.94	32.04	32.06	31.99	31.91	31.99	32.15
30-35									31.89	32.14	31.93	32.26	32.19	32.14	32.09	32.06	32.11	32.26	32.12	32.07	32.32	32.14	
35-40									31.96	32.24	32.11			32.20	32.14	32.14	32.16	32.30	32.21	32.20	32.80	32.26	
40-45									32.11	32.32	32.26			32.23	32.20	32.24		32.23	32.25	32.29		32.39	
45-50										32.41	32.38			32.21	32.26	32.32			32.33	32.38		32.42	
50-55														32.18	32.32	32.49			32.38	32.46		32.43	
55-60																							
60-65																							

* Malfunction of the CTD probe

** Not sampled

Table 4. Descriptive statistics of the length measurements (mm) of capelin (A), Atlantic herring (B), and Atlantic mackerel (C) larvae sampled during the July 2007 survey.

(A) Capelin

Station	Mean	Std. Dev.	Minimum	Maximum	Range	n
1	7.47	1.56	5.09	9.78	4.69	13
2	5.01	1.25	3.12	7.60	4.48	19
3	5.41	0.74	4.27	6.29	2.02	10
5	6.21	1.56	3.34	11.20	7.86	41
6	6.50	1.88	4.41	10.00	5.59	10
7	6.90	2.01	4.63	11.20	6.57	14
8	5.65	0.20	5.53	5.88	0.35	3
9	8.72	---	---	---	---	1
10	6.63	2.04	4.88	9.47	4.59	5
11	6.23	1.16	4.91	8.11	3.20	10
13	5.64	0.70	4.21	6.41	2.20	12
15	6.51	1.40	4.89	7.41	2.52	3
16	5.46	0.60	4.33	6.46	2.13	9
17	4.96	0.43	4.65	5.26	0.61	2
20	6.63	2.22	5.06	8.20	3.14	2
21	5.04	0.55	4.37	6.33	1.96	16
30	9.58	2.03	8.12	11.90	3.78	3
31	8.52	3.23	4.87	11.00	6.13	3
32	7.68	0.81	7.12	8.60	1.48	3
33	6.81	1.59	5.17	9.92	4.75	9
34	9.17	2.57	5.69	12.10	6.41	10
35	7.41	1.87	3.52	9.94	6.42	11
36	7.14	1.61	5.35	10.20	4.85	19
37	8.33	1.67	5.75	12.00	6.25	50
39	9.61	1.32	7.89	11.50	3.61	5
40	4.70	0.30	4.28	5.55	1.27	18
41	7.99	2.07	4.47	11.30	6.83	50
42	8.70	---	---	---	---	1
43	5.04	0.63	3.92	5.95	2.03	15
44	5.80	0.64	4.05	6.84	2.79	50
45	7.83	2.00	5.42	12.20	6.78	17
46	4.30	0.39	3.17	5.21	2.04	50
TOTAL	6.49	2.00	3.12	12.20	9.08	484

Table 4. (Continued).

(B) Atlantic herring

Station	Mean	Std. Dev.	Minimum	Maximum	Range	n
1	12.61	3.13	9.23	17.50	8.27	5
3	15.30	---	---	---	---	1
7	10.70	---	---	---	---	1
8	9.30	---	---	---	---	1
10	9.80	---	---	---	---	1
11	13.51	4.23	8.62	16.10	7.48	3
12	14.10	---	---	---	---	1
13	16.00	---	---	---	---	1
15	10.90	---	---	---	---	1
16	20.60	---	---	---	---	1
17	12.80	---	---	---	---	1
20	18.70	---	---	---	---	1
21	15.23	4.09	11.50	19.60	8.10	3
23	14.65	1.91	13.30	16.00	2.70	2
27	12.37	0.31	12.10	12.70	0.60	3
28	12.80	0.69	12.00	13.20	1.20	3
30	18.70	---	---	---	---	1
31	16.04	1.90	13.20	19.00	5.80	8
32	17.13	2.15	14.90	19.20	4.30	3
33	12.23	1.01	11.30	13.30	2.00	3
35	14.35	1.75	12.00	18.40	6.40	15
36	13.73	0.98	12.60	14.30	1.70	3
37	13.21	2.71	8.31	15.60	7.29	9
38	14.97	1.40	13.60	16.40	2.80	3
41	15.33	1.88	13.30	17.80	4.50	4
42	12.52	1.54	9.85	14.10	4.25	7
44	14.10	---	---	---	---	1
TOTAL	14.08	2.59	8.31	20.60	12.29	86

Table 4. (Continued).

(C) Atlantic mackerel

Station	Mean	Std. Dev.	Minimum	Maximum	Range	n
1	2.58	0.46	1.89	3.08	1.19	7
2	2.93	0.57	2.09	3.55	1.46	5
3	3.19	0.51	2.39	4.53	2.14	19
5	2.49	0.15	2.28	2.60	0.32	4
6	2.82	0.51	1.95	3.80	1.85	9
7	3.23	0.44	2.85	3.76	0.91	4
8	2.85	0.74	2.03	4.58	2.55	10
9	2.81	0.36	2.24	3.13	0.89	5
10	3.75	---	---	---	---	1
11	3.05	0.31	2.80	3.50	0.70	4
12	2.89	0.34	2.35	3.58	1.23	16
13	3.43	1.55	2.27	6.17	3.90	8
15	4.01	1.30	2.86	5.96	3.10	10
16	5.15	1.74	3.00	8.03	5.03	8
17	7.94	3.20	5.67	10.20	4.53	2
19	3.32	0.70	2.58	3.98	1.40	3
21	2.82	0.71	1.63	5.78	4.15	31
23	2.77	0.26	2.47	2.97	0.50	3
25	2.66	0.42	2.36	2.95	0.59	2
26	2.34	0.42	1.75	3.14	1.39	11
27	4.36	1.57	1.97	9.95	7.98	25
30	4.90	1.33	2.72	7.09	4.37	8
31	2.99	0.82	2.25	4.99	2.74	9
32	3.59	1.22	2.31	6.81	4.50	36
33	3.37	1.16	2.10	8.13	6.03	50
34	4.21	1.13	2.86	6.58	3.72	31
35	2.93	0.74	1.68	5.88	4.20	50
36	3.83	1.02	2.36	6.01	3.65	50
37	3.76	0.99	2.65	6.68	4.03	49
38	4.18	1.47	2.46	7.63	5.17	34
39	4.01	1.28	2.36	6.85	4.49	33
40	5.54	1.81	2.62	9.46	6.84	21
41	3.55	1.15	2.25	8.92	6.67	50
42	4.82	1.49	2.10	7.13	5.03	25
43	4.74	---	---	---	---	1
44	4.58	1.51	2.52	6.68	4.16	13
45	3.47	1.52	2.07	11.40	9.33	41
46	3.32	0.55	2.51	4.84	2.33	26
TOTAL	3.66	1.33	1.63	11.40	9.77	714

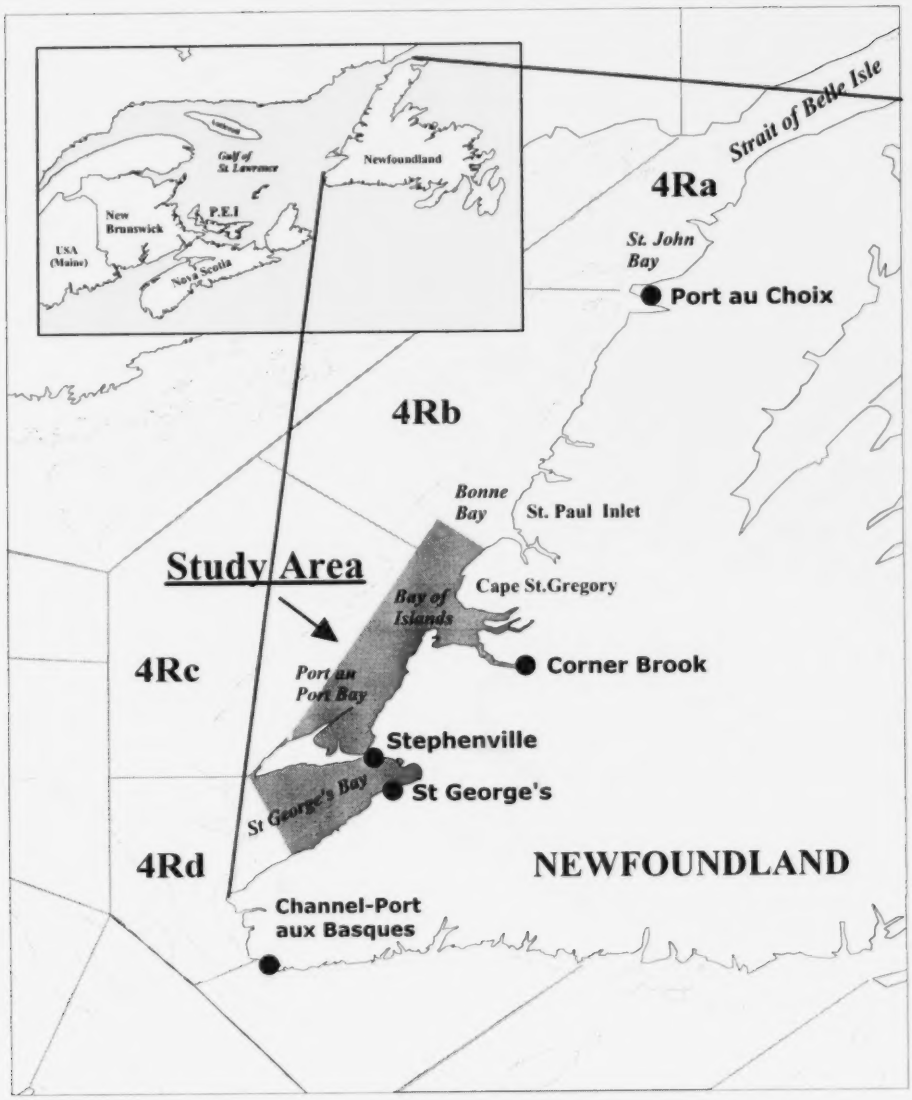


Figure 1. Map of the west coast of Newfoundland showing the study area and the other locations mentioned in the document.

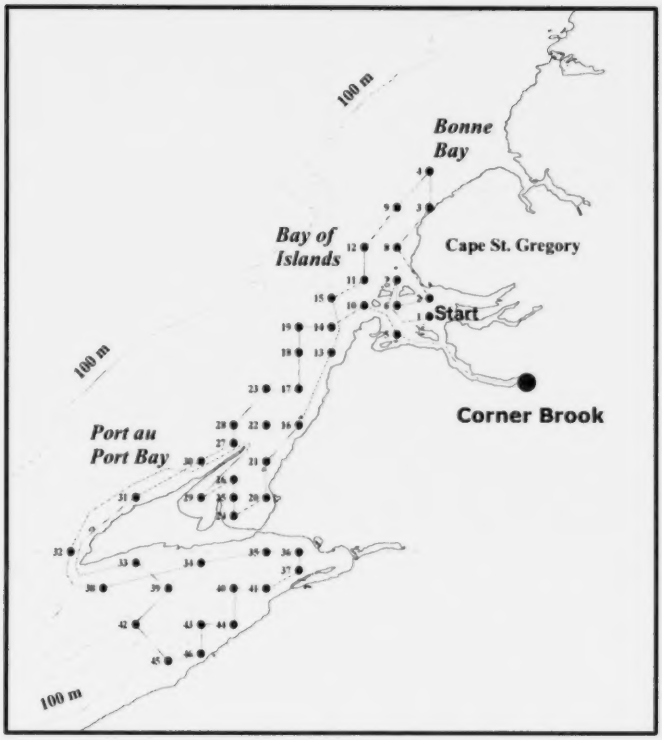


Figure 2. Map of the 46-station sampling grid of the capelin and Atlantic herring larval survey of July 2007.

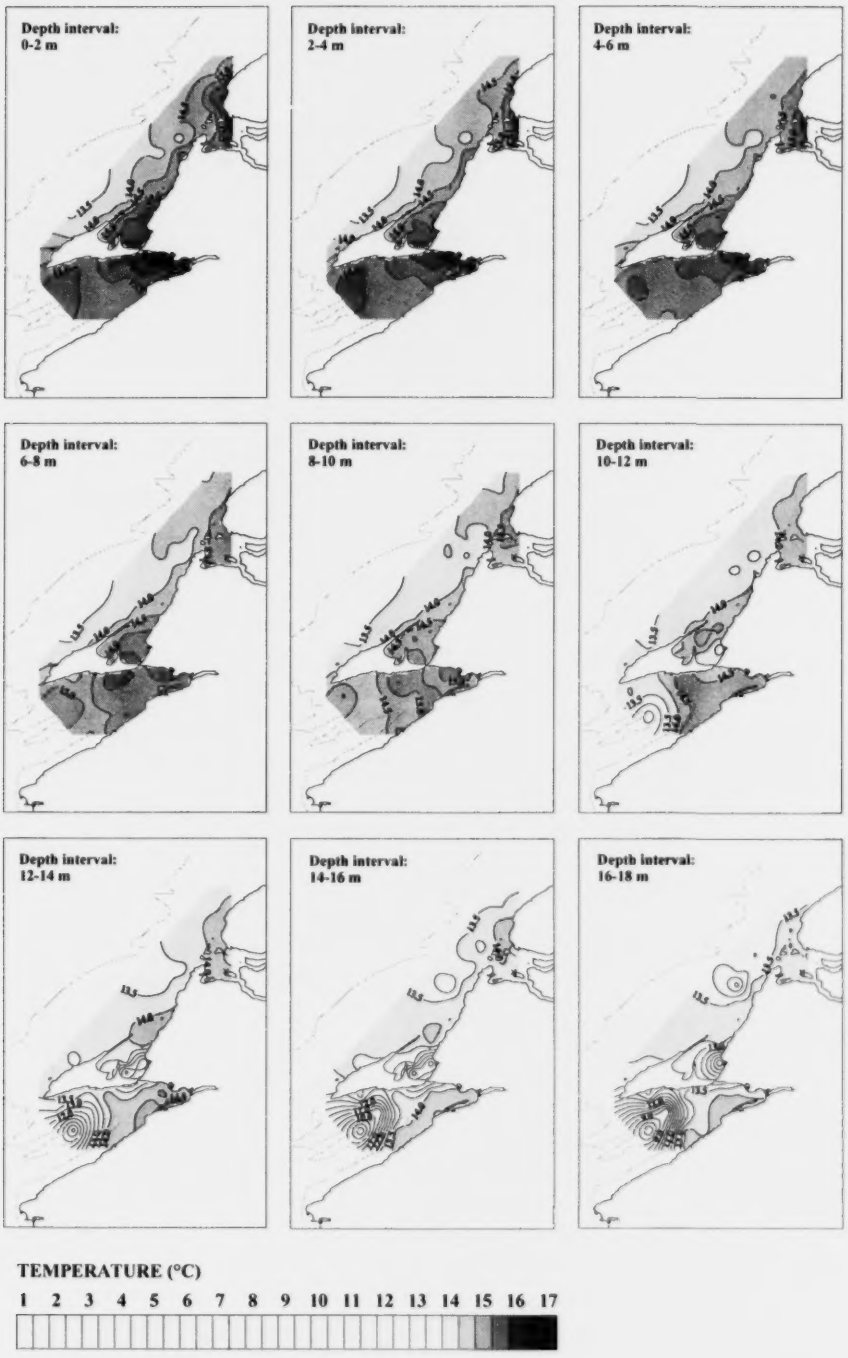


Figure 3. Mean water temperature (°C) by depth intervals of 2 m from 0 m to 20 m and intervals of 5 m between 20 m and 55 m.

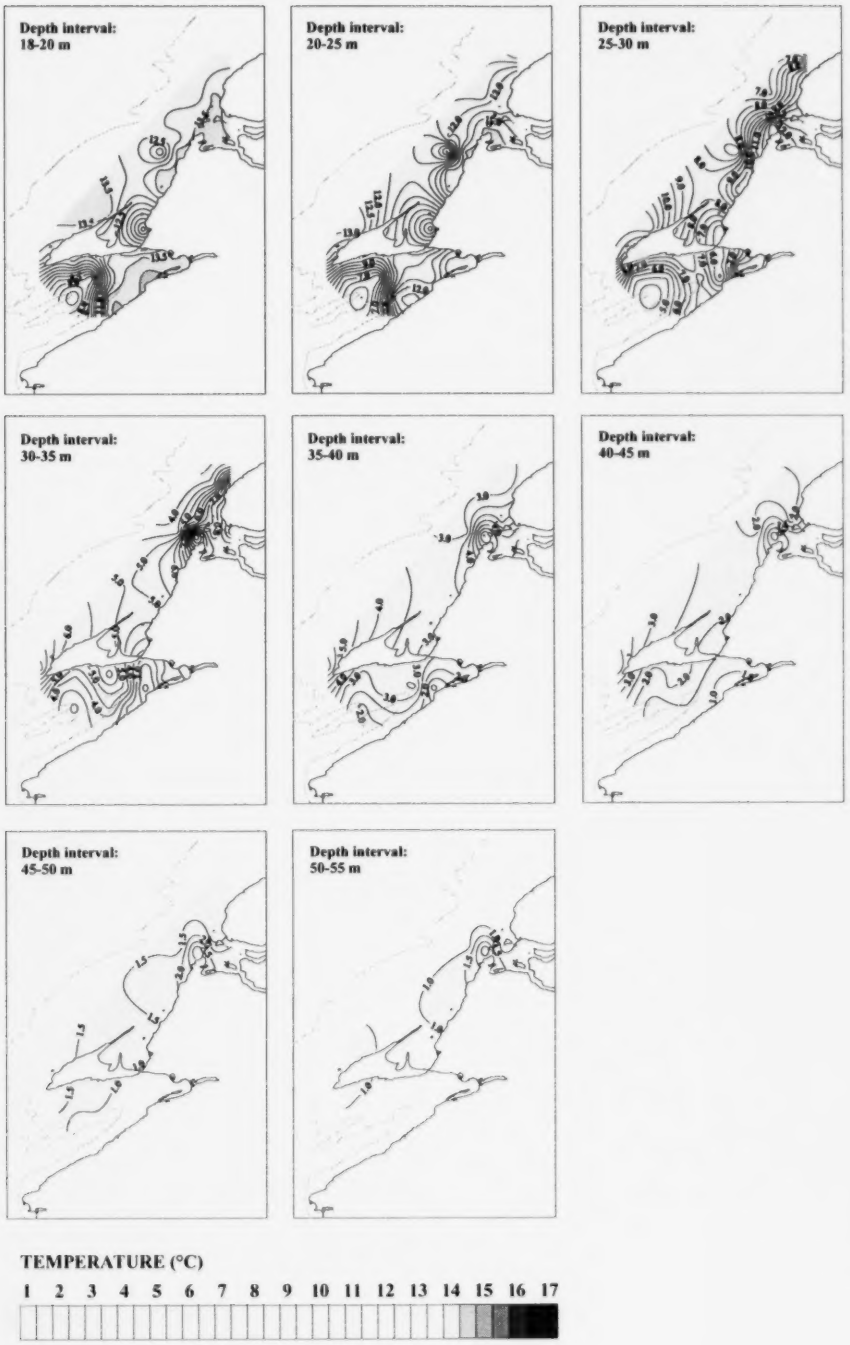


Figure 3. (Continued).

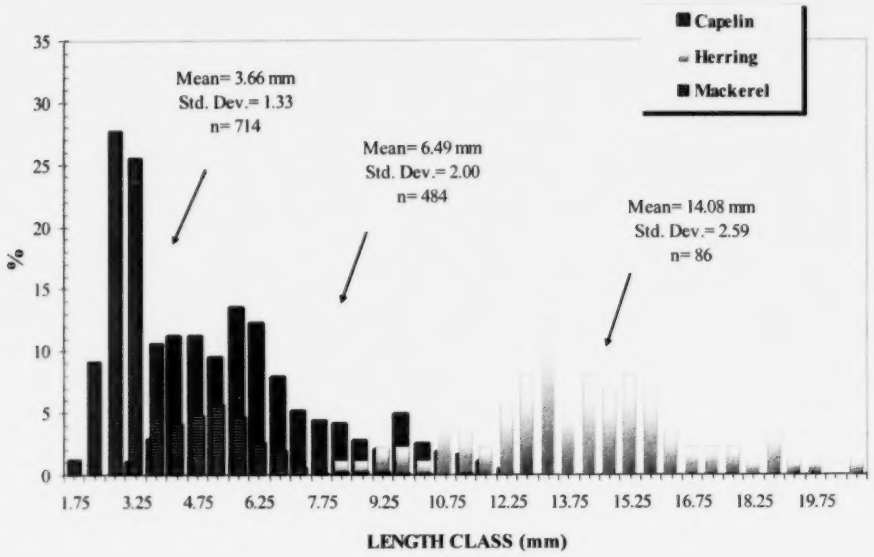
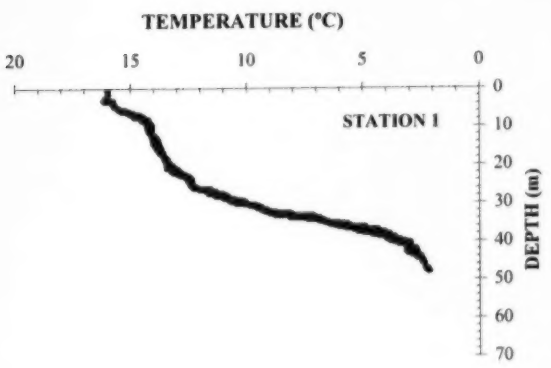
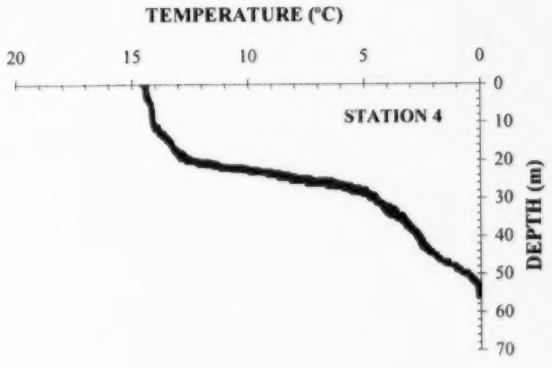
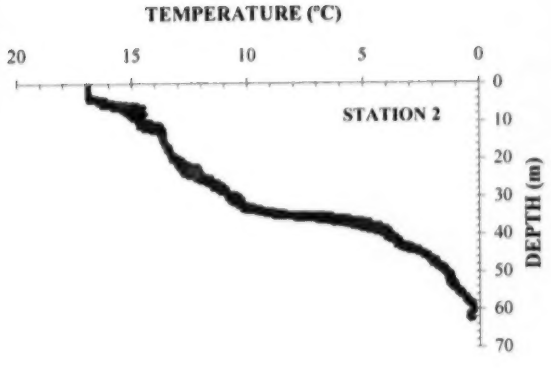


Figure 4. Length (mm) frequency distributions of capelin, Atlantic herring, and Atlantic mackerel larvae sampled during the July 2007 survey.

Appendix 1. Temperature profiles for stations sampled during the capelin and Atlantic herring larval survey of July 2007 on the west coast of Newfoundland.


TEMPERATURE (°C)
20
15
10
5
0
STATION 1
DEPTH (m)
0
10
20
30
40
50
60
70


TEMPERATURE (°C)
20
15
10
5
0
STATION 4
DEPTH (m)
0
10
20
30
40
50
60
70


TEMPERATURE (°C)
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0
STATION 2
DEPTH (m)
0
10
20
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40
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60
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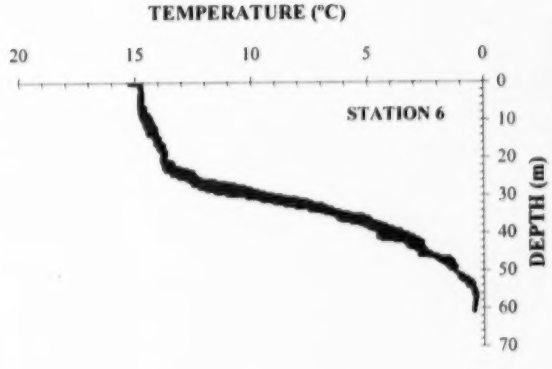
TEMPERATURE (°C)
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STATION 6
DEPTH (m)
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20
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40
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60
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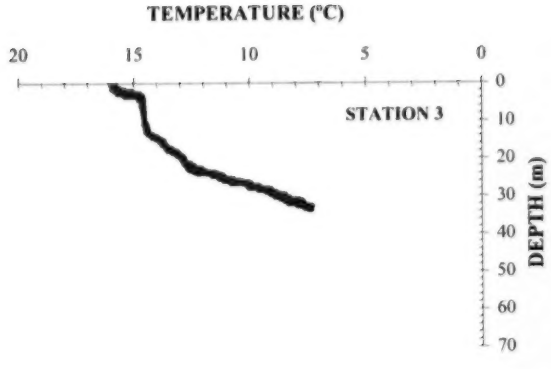
TEMPERATURE (°C)
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STATION 3
DEPTH (m)
0
10
20
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40
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60
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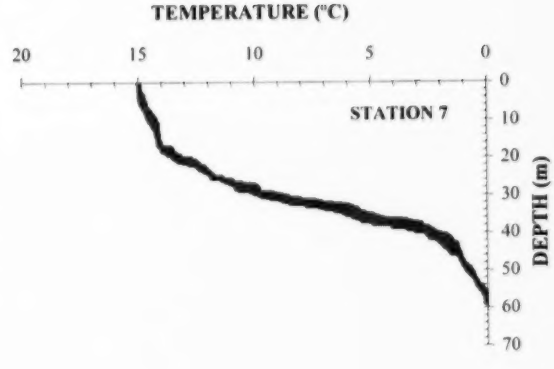
TEMPERATURE (°C)
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15
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5
0
STATION 7
DEPTH (m)
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10
20
30
40
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60
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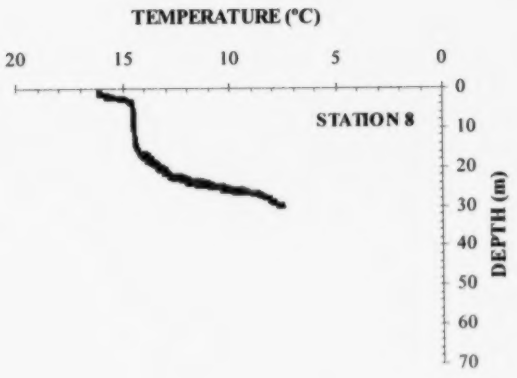
TEMPERATURE (°C)
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STATION 8
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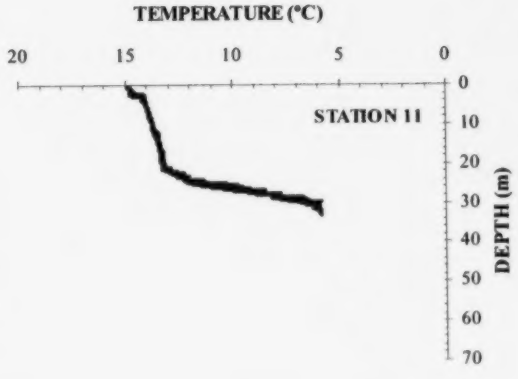
60
70
DEPTH (m)


TEMPERATURE (°C)
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5
0
STATION 11
0
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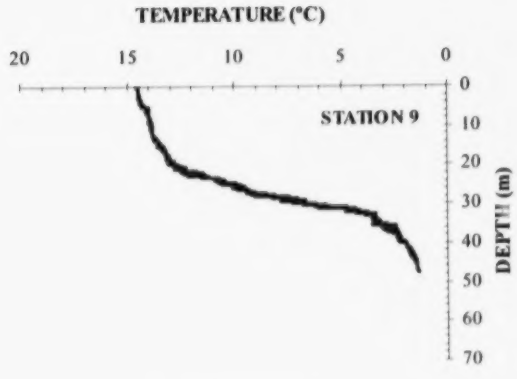
20
30
40
50
60
70
DEPTH (m)


TEMPERATURE (°C)
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STATION 9
0
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60
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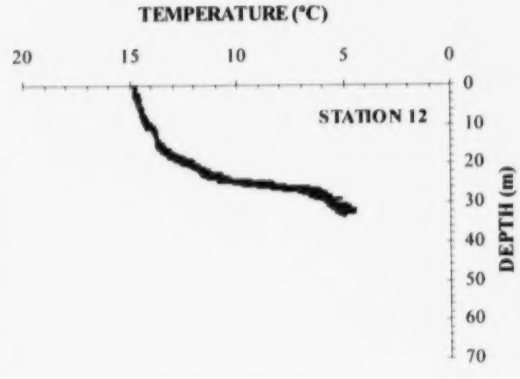
DEPTH (m)


TEMPERATURE (°C)
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15
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STATION 12
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20
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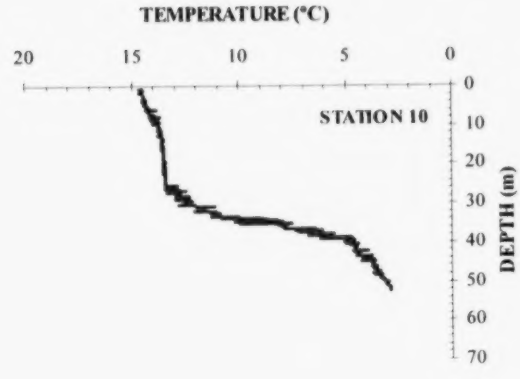
50
60
70
DEPTH (m)


TEMPERATURE (°C)
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STATION 10
0
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20
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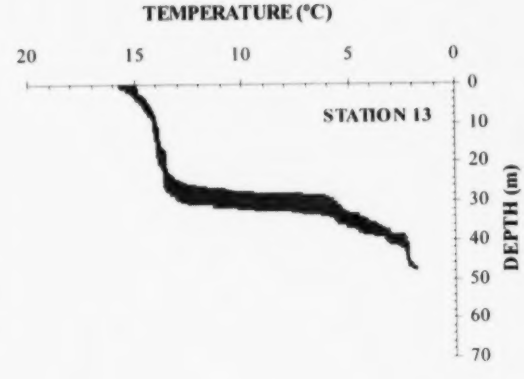
40
50
60
70
DEPTH (m)


TEMPERATURE (°C)
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15
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STATION 13
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20
30
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50
60
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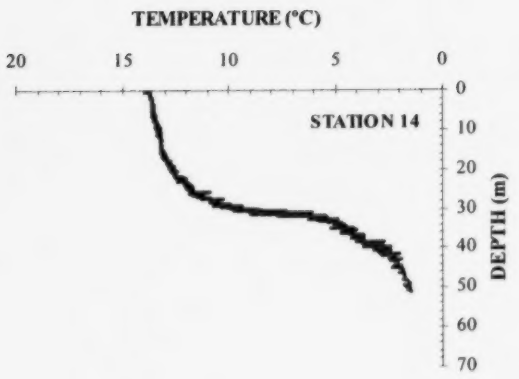
DEPTH (m)


TEMPERATURE (°C)
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STATION 14
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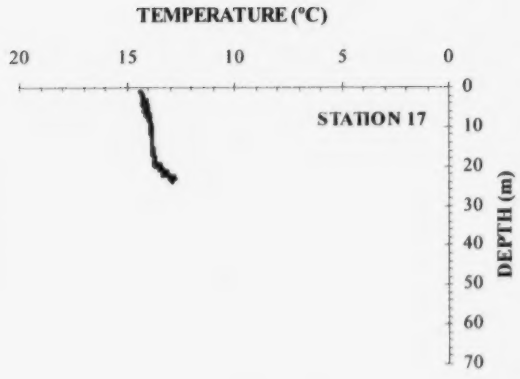
60
70
DEPTH (m)


TEMPERATURE (°C)
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15
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STATION 17
0
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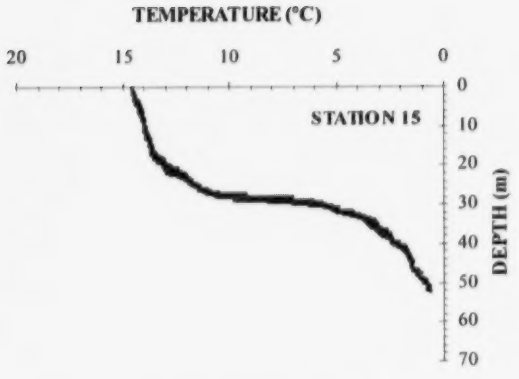
40
50
60
70
DEPTH (m)


TEMPERATURE (°C)
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5
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STATION 15
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20
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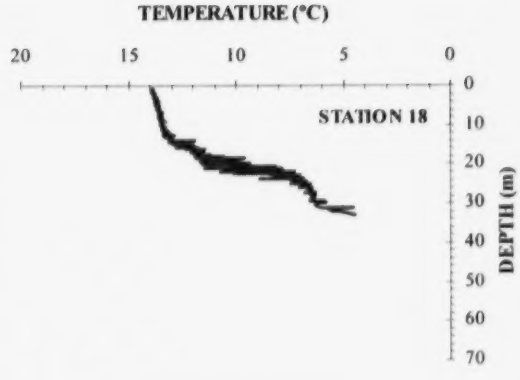
40
50
60
70
DEPTH (m)


TEMPERATURE (°C)
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50
60
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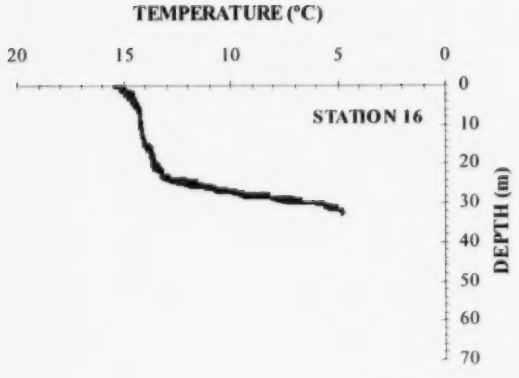
DEPTH (m)


TEMPERATURE (°C)
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STATION 16
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60
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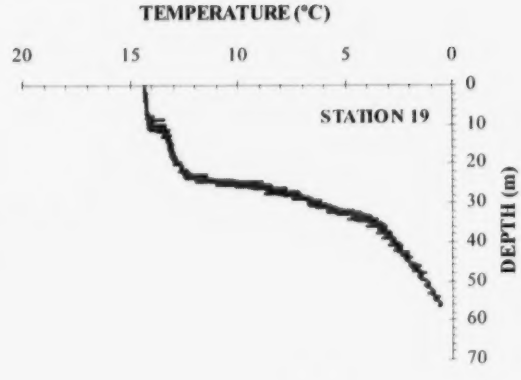
DEPTH (m)


TEMPERATURE (°C)
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STATION 19
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60
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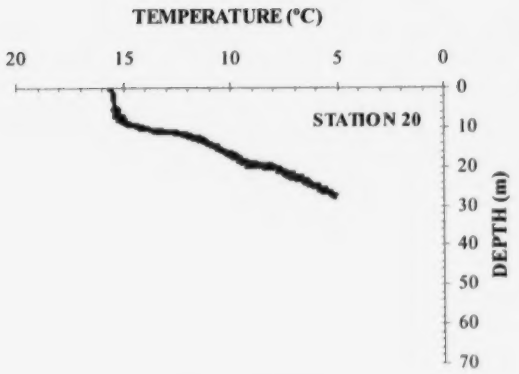
DEPTH (m)


TEMPERATURE (°C)
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STATION 20
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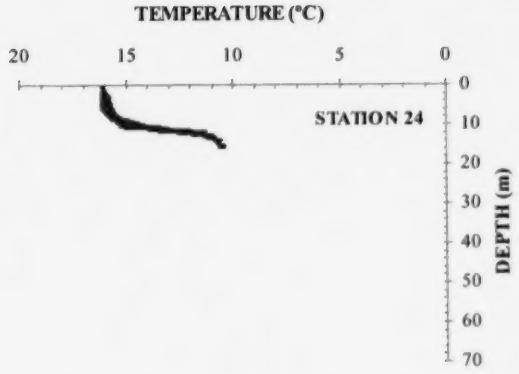
60
70
DEPTH (m)


TEMPERATURE (°C)
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STATION 24
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60
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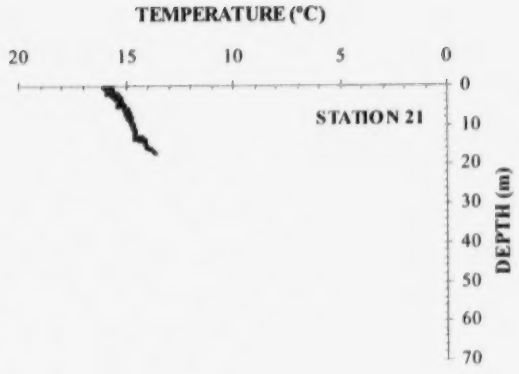
DEPTH (m)


TEMPERATURE (°C)
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STATION 21
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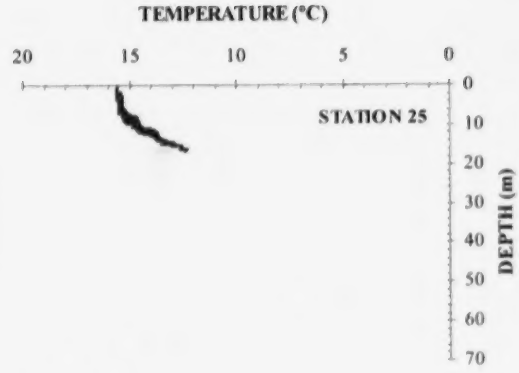
60
70
DEPTH (m)


TEMPERATURE (°C)
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5
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STATION 25
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20
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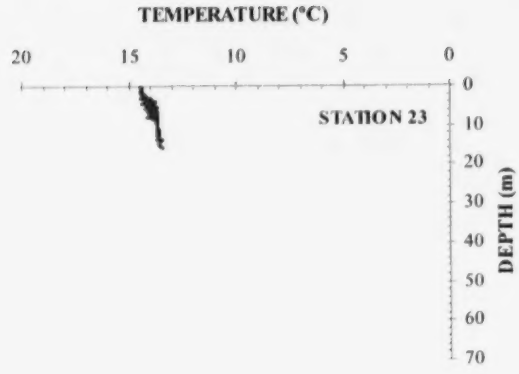
50
60
70
DEPTH (m)


TEMPERATURE (°C)
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STATION 23
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60
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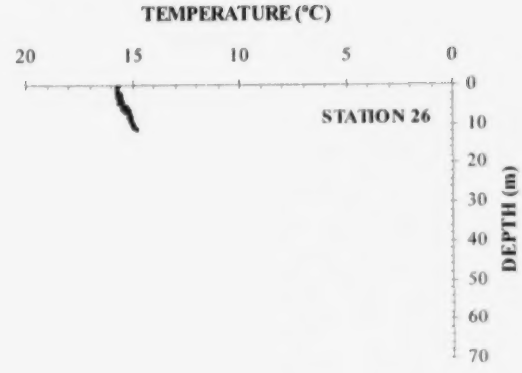
DEPTH (m)


TEMPERATURE (°C)
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STATION 26
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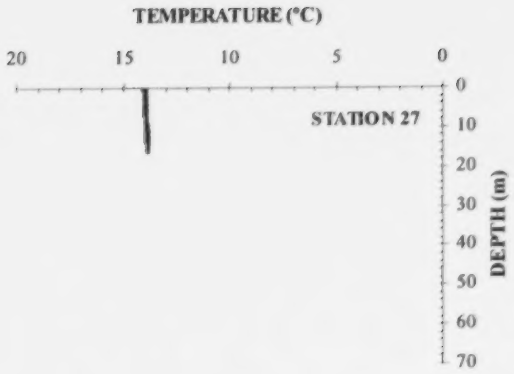
DEPTH (m)


TEMPERATURE (°C)
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15
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STATION 27
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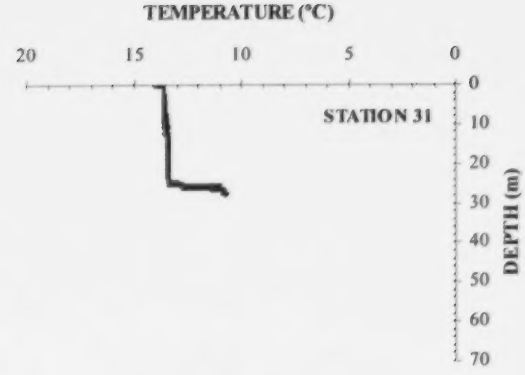
60
70
DEPTH (m)


TEMPERATURE (°C)
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STATION 31
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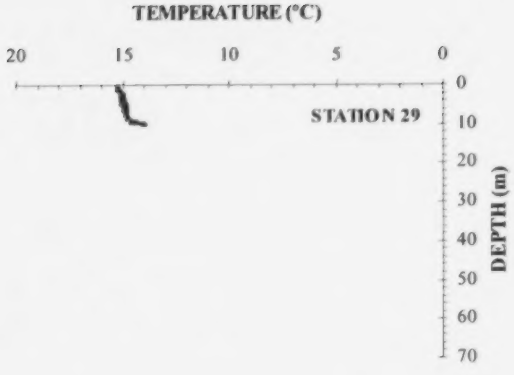
60
70
DEPTH (m)


TEMPERATURE (°C)
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STATION 29
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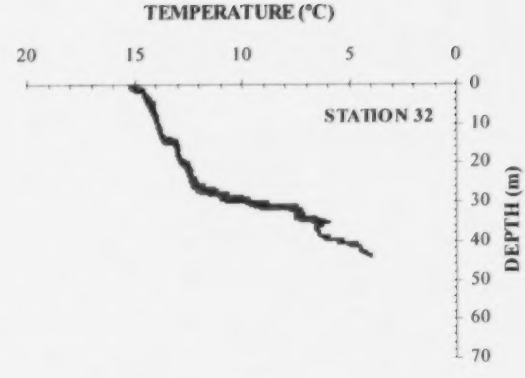
60
70
DEPTH (m)


TEMPERATURE (°C)
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STATION 32
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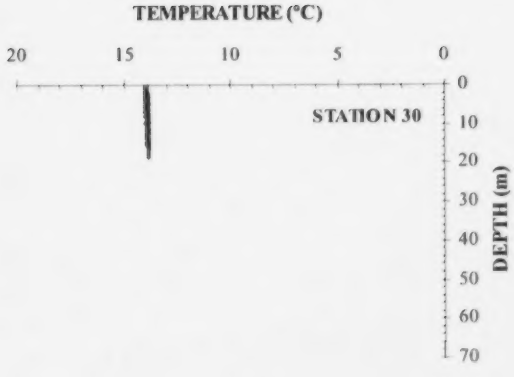
50
60
70
DEPTH (m)


TEMPERATURE (°C)
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5
0
STATION 30
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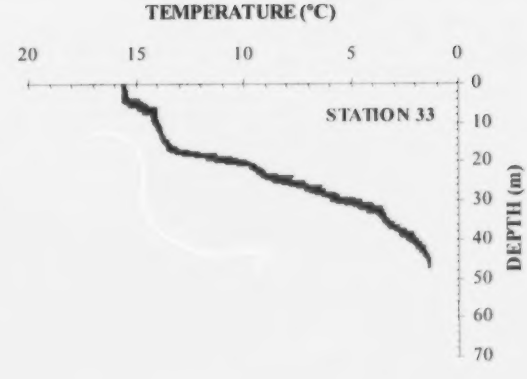
20
30
40
50
60
70
DEPTH (m)


TEMPERATURE (°C)
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15
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STATION 33
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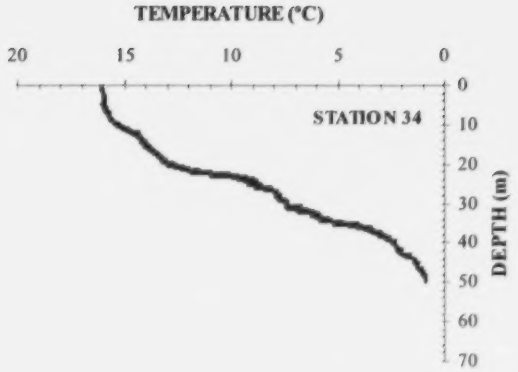
20
30
40
50
60
70
DEPTH (m)


TEMPERATURE (°C)
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15
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5
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STATION 34
0
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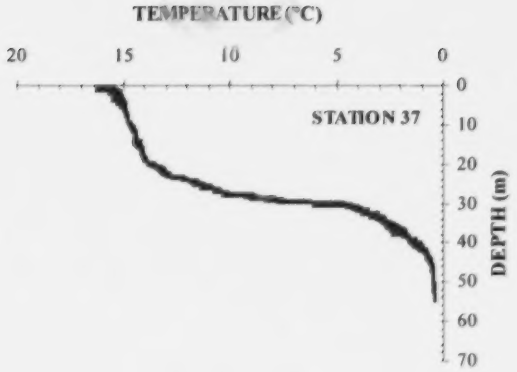
20
30
40
50
60
70
DEPTH (m)


TEMPERATURE (°C)
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15
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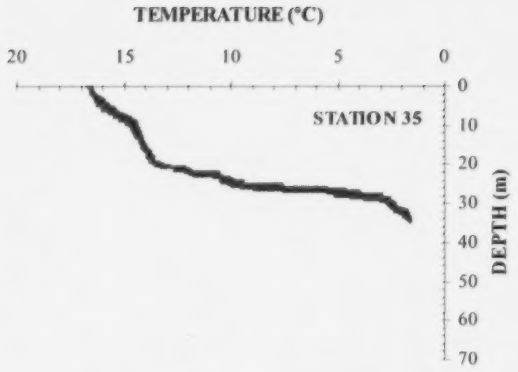
5
0
STATION 37
0
10
20
30
40
50
60
70
DEPTH (m)


TEMPERATURE (°C)
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15
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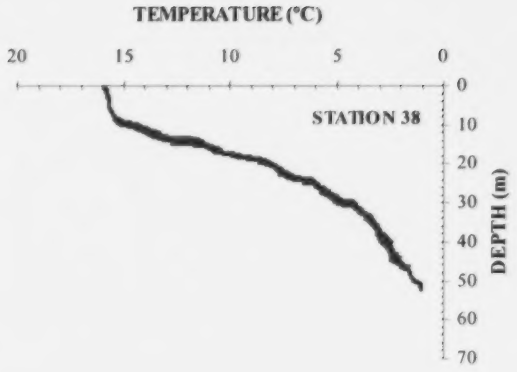
5
0
STATION 35
0
10
20
30
40
50
60
70
DEPTH (m)


TEMPERATURE (°C)
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15
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5
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STATION 38
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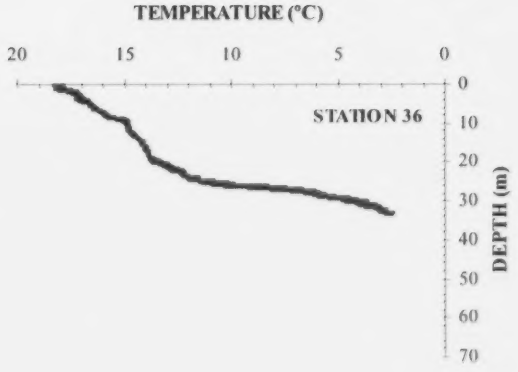
20
30
40
50
60
70
DEPTH (m)


TEMPERATURE (°C)
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STATION 36
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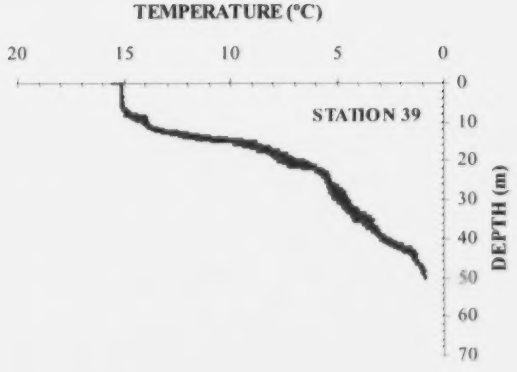
60
70
DEPTH (m)


TEMPERATURE (°C)
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STATION 39
0
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20
30
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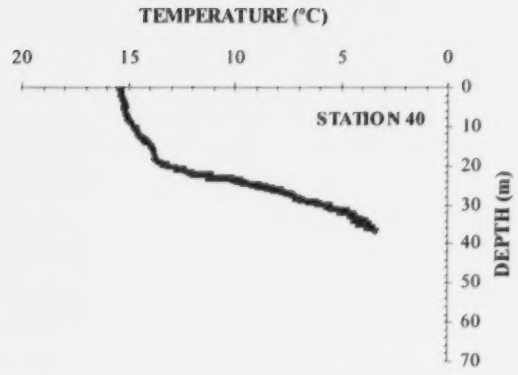
50
60
70
DEPTH (m)


TEMPERATURE (°C)
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15
10
5
0
STATION 40
DEPTH (m)
0
10
20
30
40
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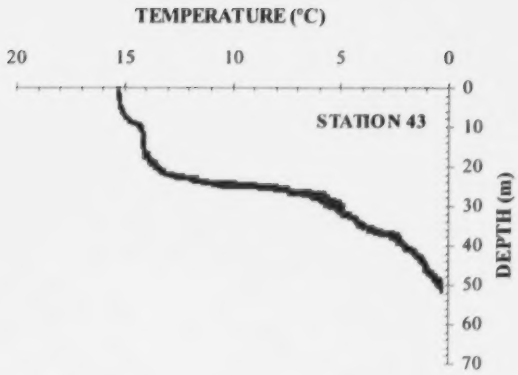
60
70


TEMPERATURE (°C)
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15
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5
0
STATION 43
DEPTH (m)
0
10
20
30
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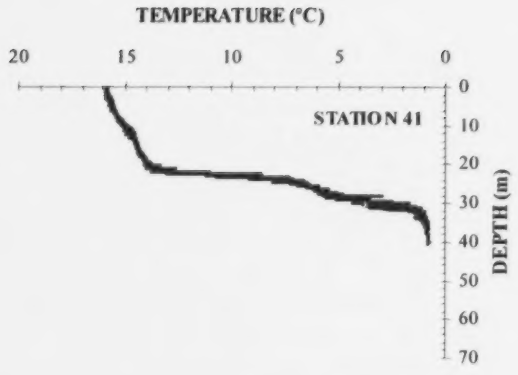
60
70


TEMPERATURE (°C)
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15
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5
0
STATION 41
DEPTH (m)
0
10
20
30
40
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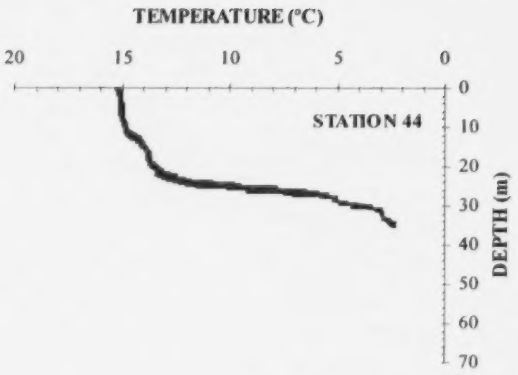
60
70


TEMPERATURE (°C)
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15
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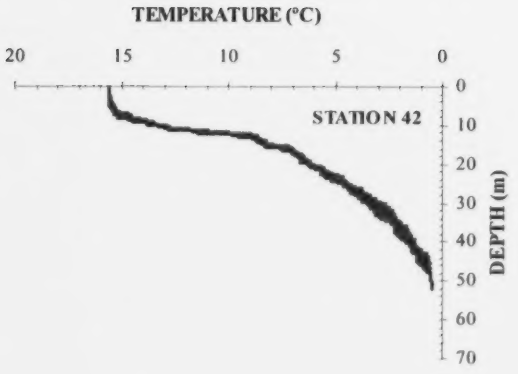
5
0
STATION 44
DEPTH (m)
0
10
20
30
40
50
60
70


TEMPERATURE (°C)
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5
0
STATION 42
DEPTH (m)
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10
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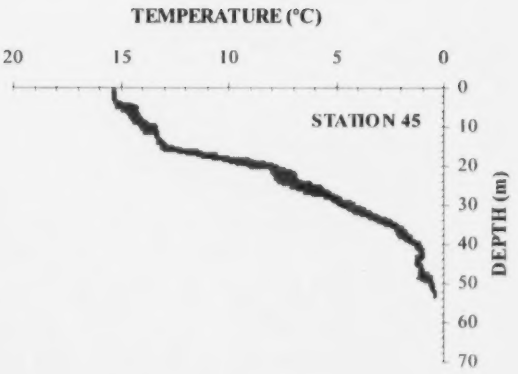
30
40
50
60
70


TEMPERATURE (°C)
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5
0
STATION 45
DEPTH (m)
0
10
20
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40
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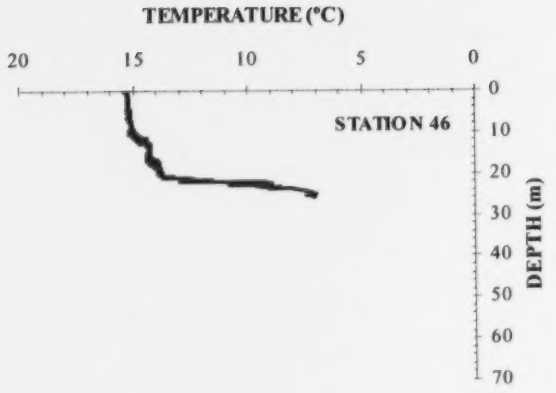
60
70


TEMPERATURE (°C)
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15
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5
0
STATION 46
0
10
20
30
40
50
60
70
DEPTH (m)

Appendix 2. Volume of the plankton sample (mL) and number of eggs sorted and identified from samples collected during the capelin and Atlantic herring larval survey of July 2007 on the west coast of Newfoundland. Egg codes are as follows: H4B = hake (*Urophycis* sp.), fourbeard rockling (*Enchelyopus cimbrius*), and butterfish (*Peprilus triacanthus*); CHW = cod (*Gadus morhua*), haddock (*Melanogrammus aeglefinus)*, and witch flounder (*Glyptocephalus cynoglossus*); CYT = cunner (*Tautogolabrus adspersus*) and yellowtail flounder (*Limanda ferruginea*).

Descriptions and pictures of mackerel eggs are found in Girard (2000).

Station	Sample volume (mL)	Eggs (n)									
		Mackerel					H4B	CHW	CYT	American plaice *(Hippoglossoides platessoides)*	Windowpane *(Scophthalmus aquosus)*
		Stage 1	Stage 2	Stage 3	Stage 4	Stage 5					
1	155	1	1	5	4	0	6	30	1608	2	0
2	140	0	1	2	1	1	4	30	160	2	0
3	90	10	3	2	0	0	16	10	416	0	0
4	110	0	0	0	0	0	0	222	0	0	0
5	90	2	5	15	9	0	24	28	1864	0	0
6	110	5	0	4	3	0	2	160	496	1	0
7	140	2	0	0	2	0	4	10	146	1	0
8	80	10	3	0	1	1	2	30	704	0	0
9	170	3	0	1	1	0	2	280	26	0	0
10	75	0	0	0	1	0	0	78	370	1	0
11	70	2	0	0	2	1	4	44	112	0	0
12	150	6	0	0	1	1	4	116	36	2	0
13	90	4	2	5	0	1	0	56	2976	0	0
14	50	0	0	0	0	0	0	90	4	0	0
15	60	2	0	3	2	0	1	304	448	1	0
16	75	2	2	10	4	0	16	32	4592	0	0
17	30	1	0	0	2	0	0	38	768	0	0
18	40	0	0	0	0	0	0	196	0	0	0
19	100	0	0	0	1	0	0	134	4	0	1
20	60	5	5	10	6	0	216	8	1360	0	0
21	80	3	1	15	9	2	64	20	2664	0	24
22*											
23	15	0	0	0	0	0	0	25	22	0	0
24	110	7	7	9	8	0	224	0	96	0	0
25	80	17	3	16	24	0	264	2	152	0	0
26	90	1	2	11	17	1	128	1	0	0	64
27	50	0	0	0	0	0	0	104	904	0	0
28	40	0	0	0	0	0	0	66	54	0	0

Station	Sample volume (mL)	Eggs (n)									
		Mackerel					H4B	CHW	CYT	American plaice *(Hippoglossoides platessoides)*	Windowpane *(Scophthalmus aquosus)*
		Stage 1	Stage 2	Stage 3	Stage 4	Stage 5					
29	160	43	24	3	2	3	1024	0	5824	0	704
30	85	2	0	2	0	0	10	100	8640	2	0
31	90	18	0	0	0	0	64	86	10176	0	0
32	170	10	2	3	0	0	0	180	424	0	0
33	230	17	3	10	6	0	12	262	210	2	0
34	210	12	14	60	9	0	0	364	10	0	0
35	215	9	8	20	36	0	8	47	920	0	8
36	190	25	4	15	66	0	58	26	316	0	0
37	150	23	8	8	5	0	22	66	76	3	0
38	240	11	1	3	6	0	0	206	0	2	0
39	290	13	2	1	0	0	0	118	2	0	0
40	210	8	3	6	7	0	0	220	28	2	0
41	150	57	31	11	13	1	0	134	1280	0	8
42	230	5	1	0	0	0	4	186	12	0	0
43	80	10	2	1	1	0	1	105	145	0	0
44	140	58	18	9	4	7	8	132	4032	1	0
45	280	2	0	0	1	0	0	2	132	0	0
46	20	9	0	0	0	0	5	40	111	1	0

* Not sampled

Appendix 3. Number of larvae sorted and identified from samples collected during the capelin and Atlantic herring larval survey of July 2007 on the west coast of Newfoundland. Scientific names are as follows: mackerel (*Scomber scombrus*), sand lance (*Ammodytes* sp.), herring (*Clupea harengus harengus*), cod (*Gadus morhua*), snailfish (*Liparis* sp.), capelin (*Mallotus villosus*), redfish (*Sebastes* sp.), arctic shanny (*Stichaeus punctatus*), radiated shanny (*Ulvaria subbifurcata*), fourbeard rockling (*Enchelyopus cimbrius*), righteye flounder (Pleuronectidae), cunner (*Tautogolabrus adspersus*), and windowpane flounder (*Scophthalmus aquosus*). Also included are counts of broken and other unidentified larvae.

Station	Mackerel	Sand Lance	Herring	Cod	Snailfish	Capelin	Redfish	Arctic shanny	Radiated shanny	Fourbeard rockling	Righteye flounder	Cunner	Windowpane flounder	Broken larvae	Other larvae not identified
1	7	0	6	5	4	15	5	0	8	6	32	1096	0	0	2
2	6	0	0	6	2	19	6	0	0	6	20	312	0	0	2
3	20	0	1	7	1	10	0	0	0	0	168	600	0	0	0
4	0	0	0	22	14	0	0	0	2	0	52	0	0	0	4
5	4	0	0	8	0	44	1	0	0	0	8	304	0	72	0
6	9	0	0	8	0	13	0	2	4	6	28	54	4	0	2
7	4	0	1	3	0	14	1	0	0	4	36	180	2	0	1
8	8	0	0	2	0	3	0	0	0	0	36	132	0	0	0
9	5	0	0	5	2	1	2	0	0	0	50	0	0	0	0
10	1	0	1	4	2	5	0	0	6	4	24	42	0	0	0
11	4	0	3	8	0	10	0	0	3	4	20	106	0	0	0
12	16	0	1	17	0	0	0	0	0	0	254	24	0	0	0
13	8	0	1	4	4	12	0	0	6	0	42	108	2	0	7
14	0	0	0	18	8	0	0	0	0	0	10	6	0	0	0
15	10	0	1	4	1	3	0	0	8	4	16	70	0	0	0
16	8	0	1	0	0	10	0	0	0	10	54	96	0	0	2
17	2	0	1	1	0	2	1	0	7	0	12	20	0	0	0
18	0	0	0	20	0	0	2	0	0	0	32	0	0	0	0
19	3	0	0	2	2	0	0	0	7	1	17	18	0	0	0
20	0	0	1	0	0	2	0	0	1	21	6	42	1	0	0
21	35	0	3	0	0	16	0	0	4	62	58	1408	4	0	5
22*															0
23	5	3	0	0	0	0	2	0	1	0	4	25	0	0	0
24	0	1	0	0	0	0	0	0	1	84	0	156	0	0	0
25	4	0	0	0	0	0	0	0	0	184	0	600	4	0	0
26	13	0	0	0	0	0	0	0	2	104	6	240	6	0	3
27	46	4	6	4	0	0	0	0	86	0	26	66	0	0	0
28	0	2	6	2	0	0	0	0	14	0	44	22	0	0	0

Station	Mackerel	Sand Lance	Herring	Cod	Snailfish	Capelin	Redfish	Arctic shanny	Radiated shanny	Fourbeard rockling	Righteye flounder	Cunner	Windowpane flounder	Broken larvae	Other larvae not identified
29	0	0	0	0	0	0	0	0	0	16	2	46	0	0	0
30	8	0	1	2	0	3	1	0	36	4	90	32	0	0	0
31	9	0	8	3	0	3	8	0	32	0	34	16	0	0	1
32	38	5	3	0	2	4	14	0	2	2	10	26	0	0	0
33	82	0	3	12	0	9	0	0	6	6	156	58	0	0	1
34	31	0	0	5	2	11	0	0	2	0	70	88	0	0	0
35	200	0	0	4	1	12	0	12	0	14	108	186	2	1	3
36	199	0	5	5	0	20	0	0	2	8	20	140	6	0	1
37	81	0	9	7	0	56	0	0	0	1	82	46	4	0	1
38	39	0	3	5	1	0	2	1	0	0	66	108	0	0	4
39	36	0	0	4	2	5	2	0	2	2	64	62	2	8	0
40	21	0	0	0	0	21	0	0	0	1	60	56	0	0	0
41	123	0	4	2	4	71	0	0	0	2	72	126	0	0	0
42	25	0	7	6	0	1	0	0	4	0	92	0	0	0	2
43	1	0	0	1	7	16	0	0	5	1	16	4	0	0	0
44	13	0	1	1	0	70	1	0	8	0	114	22	0	0	2
45	38	1	0	11	0	17	0	0	0	2	162	16	0	0	0
46	27	0	0	1	0	69	0	0	8	1	19	37	0	0	1

* Not sampled